FCC ID: OYG053320100900

EMI -- T E S T R E P O R T

Test Report No. :	**T30159-00-04XF**	September 08, 2005 Date of issue

Type / Model Name : Digital antenna + / 053320100900

Product Description : Tire Safety System

Applicant **:** BERU AG

Address : Mörikestrasse 155

71636 Ludwigsburg

Manufacturer **:** BERU AG

Address : Mörikestrasse 155

71636 Ludwigsburg

Licence holder **:** BERU AG

Address : Mörikestrasse 155

71636 Ludwigsburg

Test Result according to the standards listed in clause 1 test standards:	**POSITIVE**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15 Subpart B - Unintentional Radiators (October 01, 2004)

Part 15, Subpart B, Section 15.107(a)	AC Line conducted emissions
Part 15, Subpart B, Section 15.109(a)	Radiated emissions, general requirements
Part 15, Subpart B, Section 15.111(a)	Antenna power conduction

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2 SUMMARY

GENERAL REMARKS:

The Digital Antenna is one component of the Tire Safety System (TSS) which controls and monitors tire pressures. The system comprises the following components:

1 TSS control unit
4 sets of wheel electronics including valve
1 digital antenna
4 trigger transmitters

The Digital Antenna is a 433 MHz Receiver and during all tests, the Eut have been operated in the complete Tire Safety System (TSS), where it was possible to set the different modes via suitable software.

FINAL ASSESSMENT:

The equipment under test **fulfills** the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : September 18, 2005

Testing concluded on : September 19, 2005

Checked by:

Thomas Weise
Ich bestätige die Richtigkeit und Integrität dieses Dokuments
2005.10.05 09:31:22 +02'00'

Thomas Weise
Dipl. Ing.(FH)
Laboratory Manager

Tested by:

Xaver Fischer
Ich bin der Verfasser dieses Dokuments
2005.10.05 09:14:45 +02'00'

Xaver Fischer

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3.2 Power supply system utilised

Power supply voltage : 12 V / DC

3.3 Short description of the Equipment under Test (EuT)

The digital antenna has integrated signal conditioning (decoding processor) to receive and decode the HF signal sent by the wheel electronics. The conditioned information is transferred to the TSS control unit via a LIN communication. For exactly description please refer to the technical documents.

Number of tested samples: 1
Serial number: Prototype

EuT operation mode:

The equipment under test was operated during the measurement under the following conditions:

- Receive mode

-

-

EuT configuration:

(The CDF filled by the applicant can be viewed at the test laboratory.)

The following peripheral devices and interface cables were connected during the measurements:

- Notebook Model : IBM
- Model :
- Model :
- Model :
- Model :
- Model :

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4 TEST ENVIRONMENT

4.1 Address of the test laboratory

mikes-testingpartners gmbh
Ohmstrasse 2-4
94342 Strasskirchen
Germany

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	86-106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 /11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the mikes-testingpartners gmbh quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

4.4 Measurement Protocol for FCC, VCCI and AUSTEL

4.4.1 GENERAL INFORMATION

4.4.1.1 Test Methodology

Conducted and radiated disturbance testing is performed according to the procedures in International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 and Australian Standard AS 3548 (which are based on CISPR 22).

The Japanese standard, "Voluntary Control Council for Interference (VCCI) by Data Processing Equipment and Electronic Office Machines, Technical Requirements" is technically equivalent to CISPR 22. For official compliance, a conformance report must be sent to and accepted by the VCCI.

In compliance with FCC Docket 92-152, "Harmonization of Rules for Digital Devices Incorporate International Standards", testing for FCC compliance may be done following the ANSI C63.4-2003 procedures and using the CISPR 22 Limits.

4.4.1.2 Measurement Error

The data and results referenced in this document are true and accurate. The reader is cautioned that there is some measurement variability due to the tolerances of the test equipment that can contribute to a nominal product measurement uncertainty. The measurement uncertainty was calculated for all measurements listed in this test report according to NIS 81/5.1994 “The treatment of uncertainty in EMC measurements” and is documented in the mikes-testingpartners gmbh quality system according to DIN EN ISO/IEC 17025. Furthermore, component differences and manufacturing process variability of production units similar to that tested may result in additional product uncertainty. If necessary, refer to the test lab for the actual measurement uncertainty for specific tests. The manufacturer has the sole responsibility of continued compliance of the device.

4.4.1.3 Justification

The Equipment Under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral into it’s characteristic impedance or left unterminated. When appropriate, the cables are manually manipulated with respect to each other to obtain maximum disturbances from the unit.

4.4.2 DETAILS OF TEST PROCEDURES

4.4.2.1 General Standard Information

The test methods used comply with CISPR Publication 22, EN 55022 and AS 3548 - "Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment" and with ANSI C63.4-2003 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

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5 TEST CONDITIONS AND RESULTS

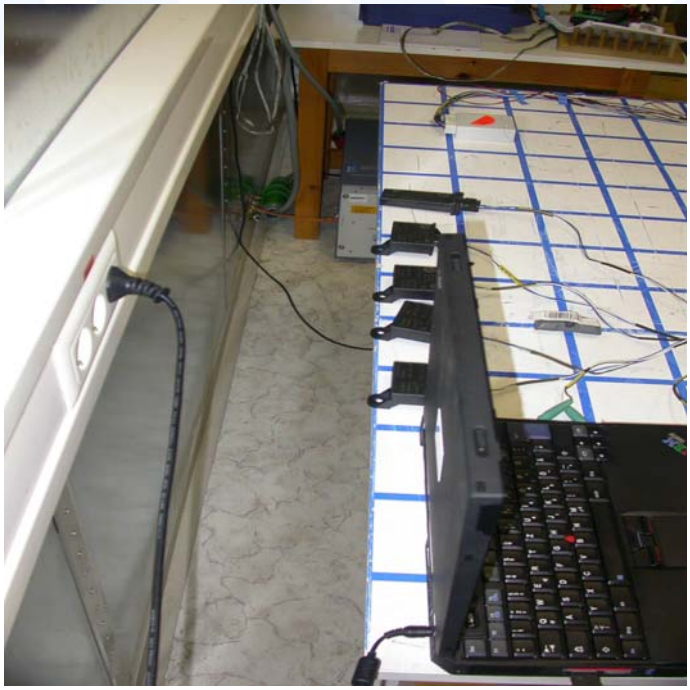
5.1 Conducted emissions

For test instruments and accessories used see section 6 Part **A 4**.

5.1.1 Description of the test location

Test location: Shielded Room S2

5.1.2 Photo documentation of the test set-up



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5.1.3 Description of Measurement

The final level, expressed in dBμV, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC Limit or to the CISPR limit, which is equivalent to the Australian AS 3548 limit.

To convert between dBμV and μV, the following conversions apply:

dBμV = 20(log μV)

μV = Inverse log(dBμV/20)

Conducted emissions on the DC power interface of the EuT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection, and a Line Impedance Stabilization Network (LISN), with 50Ω/50 μH (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimeter's above the floor and is positioned 40 centimeter's from the vertical ground plane (wall) of the screen room. If the minimum passing margin appears to be less than 20 dB with a peak mode measurement, the emissions are remeasured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

5.1.4 Test result

Frequency range:	0.15 MHz - 30 MHz
Min. limit margin	1,7 dB at 8,4 MHz

The requirements are **FULFILLED.**

Remarks: This test was performed on the complete tire safety system because the power supply for the "Digital antenna +" is provided by the control unit.

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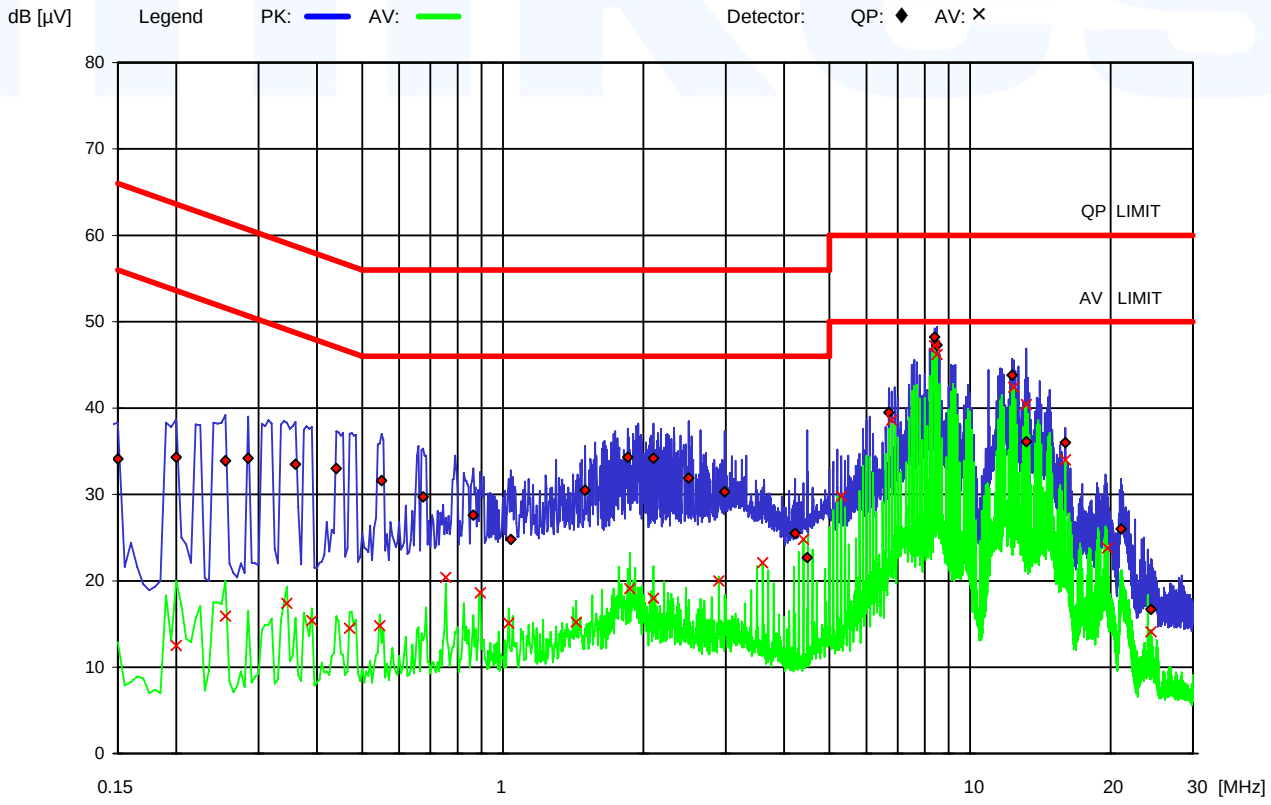
5.1.5 Test protocol

Test point Plus Result: passed
Operation mode: RX mode
Remarks:
Date: August 19, 2005
Operator: Xaver Fischer

Freq kHz	QP- L dB[µV]	D -Limit QP [dB]	Freq kHz	AV-L dB[µV]	D -Limit AV [dB]
150	34,1	31,9	200	12,5	41,1
200	34,3	29,3	255	15,9	35,7
255	33,9	27,7	345	17,4	31,7
285	34,2	26,5	390	15,4	32,7
360	33,5	25,2	470	14,5	32,0
440	33	24,1	545	14,8	31,2
550	31,6	24,4	755	20,4	25,6
675	29,7	26,3	895	18,6	27,4
865	27,6	28,4	1030	15,1	30,9
1040	24,8	31,2	1435	15,2	30,8
1500	30,5	25,5	1870	19,1	26,9
1850	34,3	21,7	2100	18	28,0
2100	34,2	21,8	2900	20	26,0
2500	31,9	24,1	3600	22,1	23,9
2985	30,3	25,7	4400	24,8	21,2

Freq kHz	QP- L dB[µV]	D -Limit QP [dB]	Freq kHz	AV-L dB[µV]	D -Limit AV [dB]
4220	25,5	30,5	5300	29,8	20,2
4480	22,7	33,3	6800	38,6	11,4
6700	39,5	20,5	8400	47,2	2,8
8400	48,2	11,8	8500	46,2	3,8
8500	47,3	12,7	12400	42,4	7,6
12300	43,8	16,2	13200	40,4	9,6
13205	36,1	23,9	16000	34	16,0
16000	36	24,0	19700	23,8	26,2
21040	26	34,0	24400	14,1	35,9
24395	16,7	43,3			



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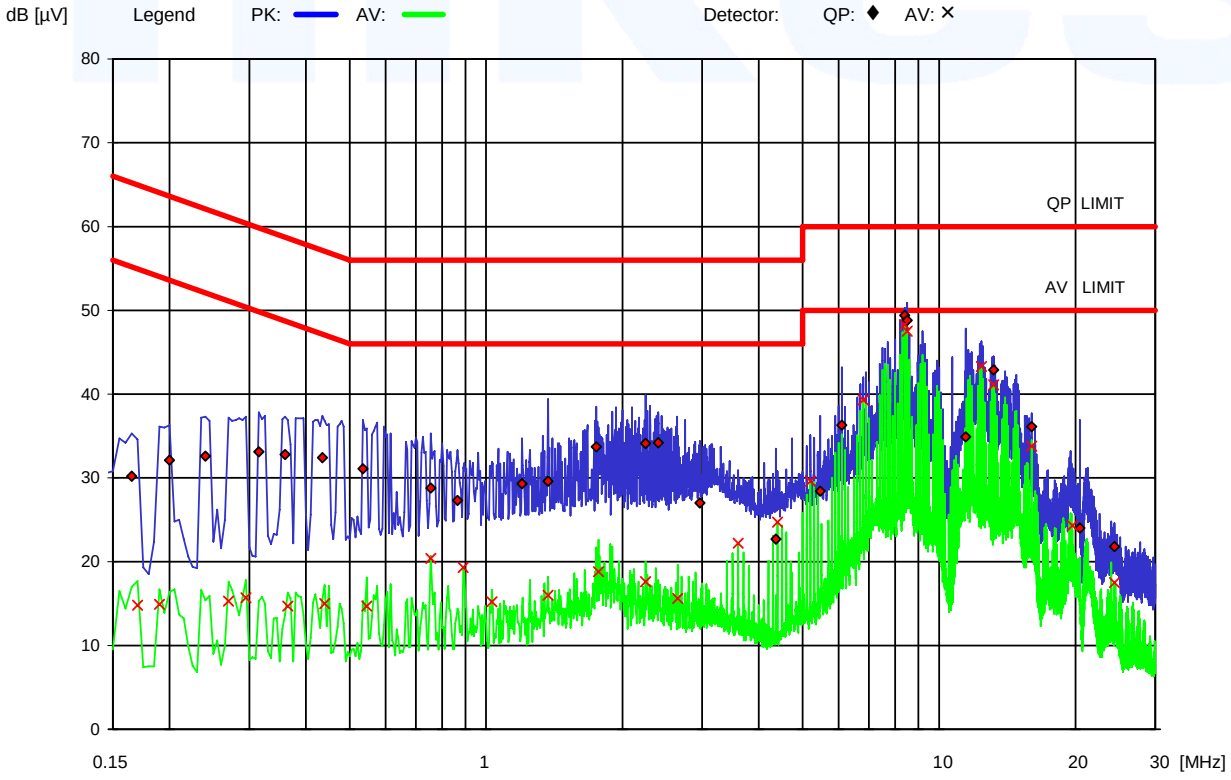
FCC ID: OYG053320100900

Test point	Minus	Result: passed
Operation mode:	RX mode	
Remarks:		
Date:	August 19, 2005	
Operator:	Xaver Fischer	

Freq	QP- L	D -Limit	Freq	AV-L	D -Limit
kHz	dB[µV]	QP [dB]	kHz	dB[µV]	AV [dB]
165	30,2	35,0	170	14,8	40,2
200	32,1	31,5	190	14,9	39,1
240	32,6	29,5	270	15,3	35,8
315	33,1	26,7	295	15,7	34,7
360	32,8	25,9	365	14,7	33,9
435	32,4	24,8	440	15	32,1
535	31,1	24,9	545	14,7	31,3
755	28,8	27,2	755	20,4	25,6
865	27,3	28,7	890	19,3	26,7
1200	29,3	26,7	1030	15,2	30,8
1370	29,6	26,4	1370	16	30,0
1750	33,7	22,3	1770	18,8	27,2
2250	34,1	21,9	2250	17,6	28,4
2400	34,2	21,8	2650	15,6	30,4
2965	27	29,0	3600	22,2	23,8

Freq	QP- L	D -Limit	Freq	AV-L	D -Limit
kHz	dB[µV]	QP [dB]	kHz	dB[µV]	AV [dB]
4365	22,7	33,3	4400	24,7	21,3
5465	28,4	31,6	5200	29,6	20,4
6100	36,3	23,7	6800	39,3	10,7
8400	49,4	10,6	8400	48,3	1,7
8500	48,8	11,2	8500	47,5	2,5
11450	34,9	25,1	12400	43,3	6,7
13200	42,9	17,1	13200	41,1	8,9
16000	36,1	23,9	16000	33,8	16,2
20465	24	36,0	19700	24,3	25,7
24400	21,8	38,2	24400	17,5	32,5



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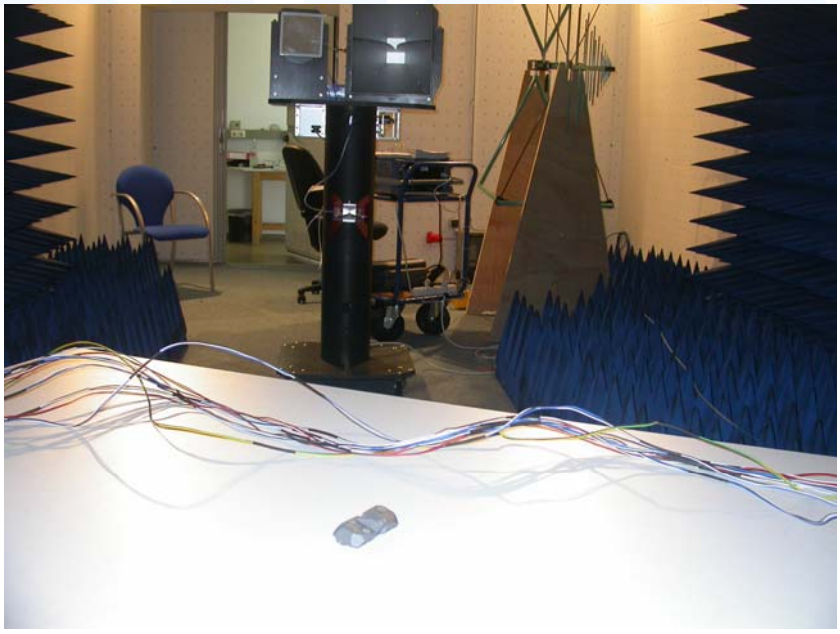
5.2 Radiated emissions (electric field)

For test instruments and accessories used see section 6 Part **SER 2, SER 3**.

5.2.1 Description of the test location

Test location: OATS1
Anechoic Chamber A2

5.2.2 Photo documentation of the test set-up



5.2.3 Description of Measurement

Radiated emissions from the EuT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003.
The Interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna was positioned 3, 10 or 30 meters horizontally from the EuT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarization`s and the EuT are rotated 360 degrees.

The final level, expressed in dBµV/m, is arrived by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (Factor dB) to it. This is done automatically in the EMI receiver, where the correction factors are stored. This result then has the FCC or CISPR limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets at page.

The radiated emissions from the EuT are measured in the frequency range of 1 GHz to maximum frequency as specified in section 15.33, using a tuned receiver (Spectrum Analyser) and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003.
The Interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna was positioned 3m horizontally from the EuT.

Measurement are made in both the horizontal and vertical planes of polarization in a fully anechoic room using a spectrum analyzer with the detector function set to peak and resolution as well as video bandwith set to 1 MHz. All tests are performed at a test-distance of 3 meters. Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration procedure the highest emission relative the limit and therefore shall be used for final testing. During the tests the EUT is rotated all around to find the maximum levels of emissions. The cables and equipment were placed and moved within the range of position likely to find their maximum emissions. When the EuT is larger than the beamwidth of the measuring antenna, the measurement antenna will be moved over the surfaces for the four sides or the test distance will be reduced to demonstrate that emissions were at maximum at the limit distance.

The resolution bandwidth during the measurement is as follows:
30 MHz – 1000 MHz: ResBW: 120 kHz
Above 1000 MHz ResBW: 1 MHz

5.2.4 Test result

Testresult in detail:(<1GHz)

Frequency [MHz]	L: QP [dBµV]	L: AV [dBµV]	Bandwidth [kHz]	Correct. [dB]	L: QP [dBµV/m]	L: AV [dBµV/m]	Limit [dBµV/m]	Delta [dB]
30-1000			120		< 30			

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Testresult in detail:(>1GHz)

Frequency [MHz]	L: PK [dBµV]	L: AV [dBµV]	Bandwidth [kHz]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	Limit AV [dBµV/m]	Delta [dB]
1000-5000			1000		< 50			

Limit according to FCC Subpart 15.109(a)

Frequency [MHz]	15.109 Limits [µV/m]	15.109 Limits [dBµV/m]
30-88	100	40
88-216	150	43,5
216-960	**200**	**46**
Above 960	**500**	**54**

The requirements are **FULFILLED.**

Remarks: According to FCC Part 15.33(b), the measurement was performed up to 5000 MHz.

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5.3 Spurious emissions (Antenna Conducted)

For test instruments and accessories used see section 6 Part **SEC 2, SEC 3**.

5.3.1 Description of the test location

Test location:
Test location:

5.3.2 Photo documentation of the test set-up

5.3.3 Test result

Testresult in detail:

SPURIOUS EMISSIONS LEVEL [dBm]								
CH1			CH2			CH3		
f[MHz]	Bandwidth [kHz]	Level [dBm]	f[MHz]	Bandwidth [kHz]	Level [dBm]	f[MHz]	Bandwidth [kHz]	Level [dBm]
Measurement uncertainty			± 3 dB					

Bandwidth [kHz]; refers to the bandwidth of the measuring receiver

Limit according to FCC Subpart 15.111(a)

Frequencies 30 - 2000 MHz
2.0nW (-57dBm)

Remarks: This test is not applicable because the receiver has only a printed antenna on PCB and no external antenna connectors.

6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used, in addition to the test accessories, are calibrated and verified regularly.

Test ID	Model / Type	Kind of Equipment	Manufacturer	Equipment No.
A 4	ESCS 30	Test Receiver	Rohde & Schwarz München	02-02/03-05-001
	ESH2-Z5	LISN	Rohde & Schwarz München	02-02/20-05-004
	ESH3-Z2	Pulse Limiter	Rohde & Schwarz München	02-02/50-05-001
	N-4000-BNC	RF Cable	mikes-testingpartners gmbh	02-02/50-05-138
	N-1500-N	RF Cable	mikes-testingpartners gmbh	02-02/50-05-140
SER 2	ESVS 30	Test Receiver	Rohde & Schwarz München	02-02/03-05-006
	VULB 9168	Trilog-Broadband Antenna	Schwarzbeck Mess-Elektronik	02-02/24-05-005
	S10162-B / +11N-50-10-5 / +	RF Cable 33 m	Huber + Suhner	02-02/50-05-031
	KK-EF393-21N-16	RF Cable 20 m	Huber + Suhner	02-02/50-05-033
	NW-2000-NB	RF Cable	Huber + Suhner	02-02/50-05-113
SER 3	FSP 30	Spectrum Analyzer	Rohde & Schwarz München	02-02/11-05-001
	AFS4-01000400-10-10P-4	RF Amplifier 1-4 GHz	PARZICH GMBH	02-02/17-05-003
	AMF-4F-04001200-15-10P	RF Amplifier 4-12 GHz	PARZICH GMBH	02-02/17-05-004
	AFS5-12001800-18-10P-6	RF Amplifier 12-18 GHz	PARZICH GMBH	02-02/17-05-005
	3117	Horn Antenna 1-18 GHz	EMCO Elektronik GmbH	02-02/24-05-009
	Sucoflex N-1600-SMA	RF Cable	novotronik Signalverarbeitung	02-02/50-05-073
	Sucoflex N-2000-SMA	RF Cable	novotronik Signalverarbeitung	02-02/50-05-075

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